White Paper Report

Report ID: 109382

Application Number: HD-51773-13

Project Director: Mark Tebeau (mtebeau@gmail.com)

Institution: Arizona State University

Reporting Period: 6/1/2013-8/31/2015

Report Due: 12/15/2015

Date Submitted: 1/20/2016

White Paper: Guide to Mobile Technology in Small History Museums
Mark Tebeau
Date of White Paper: December 1, 2015

Project Title: Museum Mobile Initiative
Grant Number: HD5177313
Division: Digital Humanities
Program: Digital Humanities Start-Up Grant
PI: Mark Tebeau, Ph.D.
Associate Professor
School of History, Philosophy, & Religious Studies
Coor 4502; 975 S. Myrtle Avenue
PO Box 874302
Arizona State University
Tempe, Arizona 85287-4302

White Paper: Guide to Mobile Technology in Small History Museums

Introduction

The bulk of small and middle-sized history museums face numerous issues related to staffing, funding, and managing collections. The digital has provided new opportunities, as well as new challenges related to making collections available digitally, as well as engaging visitors. The challenge and opportunities of engaging visitors in the spaces of museums has been advanced by the shift from desktop to mobile computing. As museum audiences carry the latest smartphones in their pockets or hands, museums have an opportunity to enhance their experience of the museum. Leading professional organizations, academics, and technology professionals have weighed in on the issues related to the mobile revolution. This white paper seeks not rehash that literature, but to try and distill some of the key issues that might be facing more modestly resourced cultural organizations, including especially small and medium-sized museums.

This white paper seeks to serve as a basic start-up guide for small and mid-sized museums considering issues including mobile interpretation in their galleries. Large resource-rich institutions have relatively more access to technical expertise, bigger budgets, and more staffing. Thus, this white paper really takes into account the situation faced at so many small museums. Typically, such institutions have only one or two paid staff members at best. Additionally, we take into account the constraints of working in such environments—issues of cost, sustainability, small staff size, and access to technological expertise. This guide also draws on the work of the Curatescape team, with funding from the NEH, to outline an approach to deploying mobile web-apps in museums that enhance interpretation and audience engagement.

Curatescape is an open-source web app developed using the open-source Omeka content management system and also a corresponding native web app that is deployed for a fee. Curatescape is used by more than forty organizations worldwide to curate landscapes as living museums. Importantly, the minimal costs associated with Curatescape allow modestly resourced

small organizations, including libraries, universities, main street groups, and preservationists, to build community partnerships in local communities and/or regions. Over the past twenty-four months, we have explored how Curatescape could be redesigned and altered for easy deployment in indoor settings, in so-called "GLAM" space of galleries, libraries, archives, and museums. This white paper largely responds to the issues we faced in thinking about this problem, and we developed a blueprint for future development in this area. It is our hope that this white paper will lay out the benefits of different approaches as regards technologies, software, or strategies. We will not make specific endorsements but discuss briefly some of the costs and benefits of different approaches, with an eye toward low-cost, easy-to-maintain, and scalable solutions.

Technologies
Among the first questions asked by museum staffs or others seeking to deploy new technologies are questions about software and hardware. These are almost always the wrong questions because they begin with a question about the tools to be used, rather than with questions about goals. For example, nobody beginning a DIY home renovation project would begin with the question of which tools to use, but would instead plan the project and then acquire and/or learn to use the appropriate tools. We recommend a similar approach to deploying mobile technologies in small and middle-size museums. We recommend first establishing project goals, including budgets, and then taking on questions related to the proper software or approaches to mobile technologies. Included in this goal-setting process should be the development of a broader digital strategy for the cultural organization. Although beyond the scope of this paper, a literature has emerged about best practices in this area.

Apps, or software applications, are the primary way to share interpretive content with museum visitors. In the world of mobile technologies, these can be apps designed and deployed on specific mobile platforms, such as those powered by iOS (Apple) operating systems (iPhones and iPads) or such as those powered by Android operating systems, which dominate the smartphone market, with about 85 percent of new units shipped worldwide in 2015. (Apple controls about 13 percent of the market, but its users tend to be more app and device savvy, according to industry statistics.) Apps designed for these specific operating systems are called native apps. They are programmed as separate pieces of software according to the guidelines for their respective operating system. And, they are distributed via the distinctive app store for the operating system. iOS and Android each have a distinctive app store with specific guidelines and practices for building and deploying on their respective platforms. Apps can be further modified and differentiated based on device size (phones verse tablets, for example) and different project specifications, such as whether the app will require a Wifi connection. Regardless of specification, native apps are independent pieces of software that must be compiled and distributed through their respective app stores.

By contrast, applications designed to operate on a web browser are called web apps. These types of apps are designed to be used on a web browser that is deployed on desktop, laptop, phone, or tablet, making them more flexible than native apps. Web apps can be accessed on any phone or computer operating system. They will function slightly differently according to the browser software being used (Safari, Firefox, Chrome, Internet Explorer, etc.) However, such differences are generally very minor, with the caveat that older browsers (and many people do use older browsers) may not work as well. Web apps require a single program code to work in multiple

different operating systems and on multiple browsers. The flexibility and simplicity of maintaining a single code base across multiple operating systems is a strength of web apps.

The differences between native apps and web apps in terms of user experience and functionality are minimal and continue to become less significant over time. When I began working in this area nearly a decade ago, the industry argued that native apps were superior in terms of functionality. In recent years the differences between native and mobile apps have continued to narrow with the advent of HTML5 and better solutions for optimizing the experience for different types of devices. The advantages of a native app are sometimes associated with superior loading speeds, functionality, and offer the opportunity for more customized design. One real advantage is that a native app can be designed to load in its entirety to a museum visitor's phone, allowing for access to content in settings where there is a marginal internet connection. The possibilities of native apps for museum settings, in terms of design and functionality, are evidenced by apps, such as the Cleveland Museum of Art's excellent Gallery One. Such large-scale expensive projects are important for their field leadership and research. They are, however, well beyond the staffing, technology, or budget capacity of most institutions.

Native apps have some disadvantages. On average, they have a relatively higher cost, with estimates for technology costs exceeding $30K. Such costs are explained by their specialized programming, and by the fact that many institutions will want to deploy separate code for both the iOS and Android operating systems. Not surprisingly, this approach comes with higher sustainability costs related to maintaining forward and backward compatibility of the code base as phone operating systems are upgraded, which occurs regularly (sometimes at intervals of less than yearly.) There would be additional costs associated with refreshing the code, to add new features, improve user experience, or modify the apps' design. Not only are the cost of building and maintaining the code of native apps substantial and beyond the capacity (or interest, depending on project goals) of a small to mid-sized museum, but also the technology costs of such a project mean there will be relatively fewer resources available for building a first-rate interpretive program or implementing a high-quality engagement & marketing strategy.

In contrast to native apps, web apps are less costly and easier to maintain, and they can be made to function very similarly to native apps. For example, web apps can be distributed through the one of the app stores, as well as be available on a browser. They're also more dependent on robust wireless connections and data plans, but they can be used anywhere and on any device with a supported web browser. In terms of cost, creating a single codebase that functions across multiple devices does not cost more than developing a native app. And, in fact, it usually costs less. Also, the cost associated with maintaining and sustaining web apps is usually considerably less. This is particularly true when using open-source content management systems (such as WordPress, Omeka, or Drupal), development costs may be substantially less over the longer term for several reasons. Open-source software communities (especially WordPress and Drupal) build and maintain these tools, allowing their cost to be distributed across a wide network of developers, whose work has built on the work of previous developers over a period of many years. Additionally, the size of these development communities means that a ready-supply of technical expertise exists. Not only does this generally lessen the cost of development, but also it provides organizations a ready supply of technical talent via the user community, making long-term maintenance both more available and easier.

This discussion has been framed in terms of deploying a mobile solution from scratch, whether using a proprietary or open-source content management system (see below for more on the advantages of open-source and standards-based content management.) However, this does not have to be the case. Using open-source tools, such as WordPress or Drupal can allow for rapid and inexpensive customization through deploying existing mobile-friendly team at a relatively low cost or with modest investments in programming talent. In addition, a variety of platforms and/or services promise to allow organizations to build and deploy apps at what amounts to the click of a few buttons. These services may provide a meaningful solution to smaller organizations, with their strengths being their apparent low cost and rapid implementation.

Typically, such solutions run the gamut from deploying apps through customizing templates and pre-created page views, and usually include a hosting package in which the customer (in this case the cultural organization) pays based on the use of the app (pageviews, bandwidth, etc.) Adopting these solutions may well provide value and support for smaller cultural organizations, but they come with significant drawbacks, including lacking the ability to be customized, locking an organization into a single solution/provider. Also, in pay-as-you go scenarios, it is not at all clear that the total project costs are less than more customized solutions. Finally, and most critically, it is not clear that such tools standards based, at least in terms of library and museums, making it so an organization's work is not transferable (except by hand) to other, more sustainable tools. The number and volume of mobile hosting platforms and authoring tools that have emerged in recent year is bewildering and it is difficult to discern which of these might be a good solution. Thus, it is hard to recommend such solutions to small and mid-sized cultural organizations.

As the incipient field of digital humanities has matured, it has strongly recommended open-source software solutions, especially emphasizing open-source content management systems (verse proprietary solutions.) The advantage of open-source software is that it can be customized by any programmer familiar with the programming languages involved, which is why this approach is recommended by humanities computing experts. Proprietary solutions can lock an institution or research project into a single vendor or technology with a relatively small community of experts. Even so, in practice, to produce a well-designed and functional software applications requires technical expertise—either in-house or externally hired. Open source does not mean free. Additionally, all digital endeavors including mobile apps, databases, and other digital projects require ongoing technology costs associated with maintenance. Such costs might be lower using off-the-shelf solutions, but that would not always be the case. Finally, it is strongly advised that mobile projects be integrated into broader institutional digital strategies

We also frequently get questions about the particular content management solutions that might be available in the form of mobile solutions for museums. Should small institutions use Omeka, WordPress, Drupal or some other open source tool? On this we have no recommendations, although there is some general guidance that we can offer. Curatescape is a framework that includes native apps for iOS and Android, as well as a web-app optimized to mobile devices. It is powered by the Omeka content management system. Based on our experience, we can recommend Omeka with some caveats. The developer community is smaller than those of WordPress or Drupal and requires more active maintenance than either of the others. We are fans

of WordPress because it is so easy to use and maintain. Also, a plethora of low-cost (or free) themes make it visually-appealing out of the box, while many of these themes are quite easily customized. Drupal, by contrast, has a higher learning curve, demanding more technology-savvy inputs, but its large developer community (which is a virtue of WordPress as well) makes it easy to customize inexpensively.

Toward this end, one of the goals of the Curatescape Mobile Museum Initiative was to explore whether and how the Curatescape themes and plugins for Omeka could be adapted from their use in interpreting landscapes as living museums to museum environments themselves. Our hope was to develop an outline of a low-cost mobile solution to small and mid-sized history museums. In our explorations, we have determined that certain factors (discussed below) peculiar to the world of small and medium-sized GLAMS, including especially their diversity may not make Curatescape ideal for small museums without significant revision or expensive individualized customization. **With that caveat, we want to emphasize a key lesson from our work. technical customization is almost certainly required for apps in any museum setting for a variety of reasons but especially those related to navigation and wayfinding.**

We also cannot emphasize enough that given the realities of engaging audiences through mobile interpretive tools, teams follow best practices in terms of using archival and library standards for project, developing a broader institution-wide digital strategy into which mobile fits, as well as focusing on making the project sustainable over several years. These recommendations especially emphasize some of the recommendation of the New Media Consortium's Horizon Reports over the past few years—deploying interpretive materials that are reusable in multiple formats and building digital projects to facilitate such re-use.

In conclusion, for smaller organizations with less elaborate budgets, we recommend deploying a web-based solution (i.e. a web app). We also recommend using a common open-source content management tool, such as WordPress or Omeka. We also recommend that the staff of a museum manage the server and initial implementation of the software, looking to regional public history, digital humanities, library science, or design firms to assist in customization toward your project's interpretive goals. However, we would emphasize that customization should be modest and within the framework of existing (and well-used) plug-ins and themes. Finally, the project should develop a focused interpretive plan for the app—it should not become a catch-all for all institutional contact with visitors and potential audiences. These interpretive goals should drive decisions about technology, with any mobile software serving them.

Geolocation, Beacons, and URLs
The mobile revolution has ushered in an era of ubiquitous computing—always available and available anywhere. This has fueled interest in using mobile devices for cultural interpretation, whether it be inside museum galleries or out doors in neighborhoods and communities. The questions generated by these two facets of availability also present two of the key interpretive challenges facing those of us interested in using mobile interpretation. First, how do we get people to use their devices to engage culture. And, second, how do we use locative awareness of devices to enhance the interpretive experience. It is to this second feature—locative awareness—that we now turn.

Museums are immersive environments. Rooms, hallways, and gallery walls shape our experience with visual cues that move our eyes to artifact and interpretation. Well-designed exhibitions spaces focus our attention on label text, as well as relevant objects nearby. Curators construct a context for our experience. Guided tours of museums emerged with the cultural form itself, as experts directed audiences' engagement and helped to create an experience. More than 60 years ago the museum audio tour was invented and such tours have been performing the work of the docent through a mediating technology. Mobile interpretation is not a departure from these traditions, but rather an extension of guiding audiences through the physical space and intellectual range of a museum and its collections.

Mobile apps can orient and engage visitors through multiple technologies. Museums that implement audio-style applications typically post numbers (or other identifying signage) in galleries. These signs indicate to audiences that they should enter the information into a playback device to retrieve and access the interpretive material. Traditionally that media has been audio, but is increasingly images or video with the advent of smart devices. Indeed, expanding use of mobile devices means that every visitor to a gallery is carrying necessary to receive media, messages, and marketing from a museum. The challenge is how to connect and engage audiences walking through a gallery. With smartphones being location aware, the challenge is how to help visitors navigate and engage museum content in which they're interested.

Smartphones are also location aware through the use of signals from global positioning systems (GPS), signals from wireless routers that can be triangulated for proximity, or through receiving signals (such as text messages) from bluetooth enabled beacons that create what are called "geofences" around a particular area. Even without these features active, phones apps can be developed to allow users to enter or gather informational cues from their environments, including shortened URLs, QR codes, or alpha-numeric information (as with audio tours.) Photo recognition algorithms also are being developed, such as the Google Goggles app, that allow users to identify art images and to gather information from the web about those images.

In practice, using GPS signals to locate one's position finely enough to relate to an item in a gallery exhibit is not yet practicable. Furious efforts by a host of major technology companies are underway to bring GPS technologies, or their proxies, to indoor environments. Google has mapped tens of thousands of indoor floorplans and is working on tools to help map and navigate indoor spaces. Apple is working on an "Indoor Positioning System." The deYoung Museum in San Francisco collaborated with a Bay area start-up to unveil an app that uses Apple's indoor positioning system. Even so, the the of these technologies is still relatively novel. Beyond major public and commercial spaces it is hard to see such tools becoming common for several more years, especially in the community of small and mid-sized cultural organizations. Another solution that is being developed is the process of using an existing (or reinvented) Wifi systems to locate audiences within ta space of a museum, such as the Cleveland Museum of Art's Galley One project. Such leading-edge projects augur future directions in the field, but are presently too technically demanding and cost prohibitive for all but the nation's leading cultural organizations.

Beacons are another promising locative technology. Beacons are low-cost, low power transmitters that use Bluetooth to deliver signals over short distances to nearby smart devices.

The term "geofence" has been used to describe the signal radius around beacons, and to suggest how they work. Once a user crosses the threshold of the geofence, their device alerts them to its presence. In a museum gallery this amount to placing a beacon nearby to an object or exhibition section that requires interpretation. As visitors approach, they're alerted. This technology, however, is still in its infancy, at least in terms of its use in cultural spaces. Not surprisingly, both Apple and Google have entered this area with beacons that work with their operating systems. iBeacon, Apple's proprietary version of the technology, sends only the most basic information to devices, and requires a 3rd party application to do anything more complicated, such as being redirected to the mobile web or an app. Google's open source Eddystone project is less restrictive, but still requires considerable technical expertise to deploy. However, as part of Google's "Physical Web" initiative, it promises to to allow beacons to transmit URLs that would lead smartphone users to the mobile web.

Cultural organizations have begun to experiment with Beacons. For example, ongoing testing by the Brooklyn Museum of Art of its ASK app provides the best example that we've seen of testing and reporting on this technology by a cultural organization. The technology has produced interesting results, suggesting some of the limitations of beacon technologies. These include the challenges of positioning them within galleries (as it turns out their signals are quite finicky, being affected by everything within the space, including museum guests.) Other limitations include short battery life, adhering the beacons to walls, and also coordinating their use and interpretation is a staff-intensive endeavor. Nonetheless, beacons should be explored by any cultural organization thinking about implementing a mobile application. As the technology matures, we would expect better options for implementation and overcoming some of the present limitations.

Other more passive (in that they are usually printed, requiring the user to enter information into a device) technologies—such as QR codes, shortened URLS, or other locational cues (think of numbered guides used by classic audio-guide applications) remain quite viable in museum and cultural spaces. QR codes are two-dimensional barcodes that possess information that are scanned by third-party apps or within an existing museum application. These images take users to a URL—either within a native app or to a URL, where users can engage additional curated multimedia materials. Shortened URLs or alpha numeric key codes work in essentially the same manner. Users open a mobile browsers or the cultural organization's app and key in the appropriate information. The smartphone then directs the visitor to the museum's interpretative materials. In many ways, the QR code, URL, or numeric identifier are like the beacon technology in that they indicate to museum audiences the presence of an interpretive space. Where they're different is that they QR codes require the audience to take a physical action (scan the code, enter a URL, etc.) where beacons promise to deliver an alert directly to a user (although in their present implementation of beacons, users have to act on the receipt of this alert.)

Indeed, as we work through the issues involved in developing a Curatescape for museums, we experimented with beacons but realized that most of what I've called passive solutions would work just fine. QR codes, coupled with shortened URLS would be a reliable and cost-effective option are easy to maintain and to implement. (Although I should note that in the future, I would expect beaconing technologies and their implementation and use, to improve dramatically.) Coupled with an effective mobile web app, a QR code w/a shortened URL, would work for

multiple reasons. QR codes and shortened URLs can be generated easily and internally by technical neophytes, including museum volunteers. Such technologies surely require cultural organizations to engage audiences in their use. But, it turns out that this is true of just about any locative media solution, whether beacons or the use of GPS signals. Indeed, from our experience, whatever technology an organization uses within a gallery, there is still a need for the organization to alert visitors to the app's presence, as well as the challenging of engaging them in its use. This need is evidenced in the literature by both the Cleveland Museum of Art, with its leading-edge Gallery One, and the Brooklyn Museum with its ASK app. Thus, it is safe to conclude that regardless of technical solutions to the problem of interpretation through mobile device, the challenge of engaging audiences about the technology cannot be dissociated from the project. And, indeed, this should encourage us to be diligent in building a strategy to integrate digital interpretive solutions and mobile technologies into the broader visitor experience.

Helping audiences navigate through the museum with a mobile application can enhance visitor experience and engagement with collection. Navigation features run the gamut as we've suggested. The gold standard at present appears to be apps that use sophisticated geolocation techniques, such as the Gallery One app at the Cleveland Museum of Art, to help patrons navigate through the museum by using signals from the Wi-Fi network. Other apps, such as the Museum of Modern Art's app, guide visitors to art by indicating the floor and gallery where the artwork resides, as well as providing maps of the museum. This strategy, which we approximated in our testing, would appear to satisfy most museum visitors who are comfortable with using the app in conjunction with a well-marked museum and existing signage. In our testing, we also tried a very limited navigation information, with only gallery identity. Visitors found this unsatisfying, demanding a clearer indication of the gallery and location of interpretive stops within the app. It would appear that including maps, as well as organizing information in terms of those gallery spaces (corresponding to a museum's physical layout) would be a best practice.

Thus, there are many possible ways to orient visitors to content within the gallery and museum, as well as the expectation that apps will orient visitors in space and help them to locate such interpretive materials. Not surprisingly, as we sought to re-conceptualize Curatescape to the needs of GLAMS, we viewed navigation and location awareness as the greatest technical challenge, which was compounded by the fact that many (all?) small and middle-sized cultural organizations have modest budgets. This precluded us from exploring the feasibility of more elaborate solutions that use Wifi networks for establishing locations. Additionally, the GPS solutions from the large players in the field (Apple or Google) were not yet suitable for use in such spaces. As we explored beaconing technology, we viewed it as quite promising but neither sufficiently developed nor practicable with Curatescape. This was partly because in our testing beacons still required us to work with third-party software and we were concerned about the ability of a small to mid-sized museum to deploy, maintain, and manage the beacons. This concern was born out in publishing testing by the Brooklyn Museum.

Additionally, in thinking about our work, we began with the hypothesis that the physical layouts of cultural spaces did not, ipso facto, provide an interpretive layer to exhibitions and collections. In retrospect, our thinking on this was incorrect. Museums, galleries, and archives do indeed have an interpretive logic to their spatial allocation, even if that organization is dictated by

antiquated or clichéd approaches or by resource constraints. For example, many historical museums organize exhibits and galleries in terms of well-worn, if not dated, approaches in the field, often with an eye toward effective utilization of space. If museum layouts are not innovative, they serve an important purpose in orienting visitors to the collections or cultural space. Typically, such layouts are expressed through print materials and signage throughout the spaces of a museum. With this in mind, we imagined that it would be best to orient visitors to galleries and spaces using by adding that material to the app's interpretive content. Our reasoning is that visitors could use existing cues in the physical layouts to navigate and connect with the app. Our presumptions were incorrect. Visitors demand clearer navigation materials. In this case, it would be in-app maps and more elaborate referencing to the physical layouts. The example of a good practice in this area is the aforementioned Museum of Modern Art (New York) app. This solution is a good one. Adopting it for Curatescape, however, would require custom maps for every setting, as well as additional fields and logistics in locational metadata (that correspond to the layout.) Additionally, we recognize that another alternative or complementary strategy could be to use of QR codes, alpha-numeric entry, or small URLs appear to be the most robust, easy to implement, and least expensive solutions for helping visitors connect to mobile interpretation at locations within galleries.

Arguably, the principle challenge for our efforts to transform Curatespace to work in the spaces of small and mid-sized GLAMs is precisely related to the challenge of creating location awareness for indoor spaces. Unfortunately, it is not clear that an off-the-shelf native or web app can be constructed in a fashion that allows it to be easily by poorly-resourced GLAMS. Additionally, if we were to create such customization for each project it would incur additional costs. Given the tight budgets of small and midsized museums, it is not clear whether this approach would be sustainable. Furthermore, making an off-the-shelf app work effectively with beacon technology might also require even more feature development. In other words, the ability to develop an indoor version of Curatescape—from use in curating large-scale landscapes, such as parks, towns, or cities—presented more challenges than we expected.

Most critically, though, we have concluded that small and mid-sized GLAMS contemplating the development of mobile apps should take seriously some of the following issues related to location awareness.

1) How complex is your museum or gallery space? More complex spaces require that you customize the app to suit visitor expectations vis-à-vis the location of interpretive materials. Customization includes in-app maps and clear indications about the location of interpretive materials.
2) Do you have the staff, either paid or volunteer, to manage the training of audiences (in how to use the app), as well as support sustaining your technical choices—whether its beacons, QR codes, or another technology? Less robust staffing and technical sophistication recommend using a solution that is easy to implement and maintaining, such as QR codes or small URLs. In exploring the use of beacon technology be sure to engage in a thorough testing period.
3) How does the mobile experience differ from and/or augment the present gallery experience? Having a clear understanding of the visitor experience, vis-à-vis their mobile devices will help organizations to build the best interpretive content.

Interpretive Goals

One of the challenges of mobile interpretation in GLAM settings is integrating traditional interpretive practices with emergent digital practices, including through mobile apps. Best practices in this area continue to be developed through the field, and it is beyond the scope of this report to outline these in their scope. Indeed, since 1952 when the first audio tour was introduced at the Stedelijk Museum in the Netherlands by Director Willem Sandberg, mobile practices have continued to evolve, both in terms of technology and technique. Interestingly, about the same time, the Cleveland Museum of Natural History (in 1951) introduced its first "mobile museum," which went out via vehicle as outreach to the city's neighborhoods. Like Sandberg's audio tour, the idea was simple to enhance and engage museum visitors and surrounding communities through innovative interpretive approaches. The breadth of these approaches is covered in the AAM's e-book, *Mobile Apps for Museums: The AAM Guide to Planning and Strategy*. Instead, we will focus on a couple different approaches to practice and theory in mobile interpretation that we hope will spur interpreters' creativity.

In recent years, the concept of "transmedia storytelling" has emerged as a technique of creating a story across multiple platforms and format, including especially the use of digital technologies, which distinguishes it from previous approaches to multimedia approaches. Transmedia approaches recognize that digital technologies complement and extend stories on physical exhibitions and other media platforms, as opposed to merely repeating that interpretive approach. Transmedia storytelling theory also suggests that how we consume information differs according to its media platform, and that as we develop interpretive work we need to account for this sensibility. For small museums, creating high-quality transmedia content may be one of the most challenging issues, because of the amount of time it requires, as well as the extent of the experience. However, such interpretive practices can push GLAMs to use digital tools as a starting point for extending and rethinking broader interpretive strategies. Finally, building on our work in conceptualizing cities as living museums, the Curatescape team emphasizes an approach to interpretation that uses layered storytelling, creating multiple paths through collections materials, rather than a single focused analytic frame. Importantly, we recommend moving beyond the interpretation of a single artifact toward a more thematic interpretative presentation that creates a context or frame for understanding individual objects or groups of objects. In this way, the digital extends and complements existing physical spaces, creating an experience that bridges from the virtual to the physical world.

Audience, Social Media, & Engagement

Regardless of technologies and/or interpretive techniques, another critical challenge confronts small and mid-sized cultural organizations seeking to implement either native or web apps. Put succinctly: the cultural organization must build audience awareness of the mobile project in order for it to succeed. This is not an "if you build it, they will come" scenario. Quite the opposite. Without a clear indication to visitors that the web or native app exists, it is unlikely that it will be used in the gallery. Indeed, introducing visitors to the digital interpretive materials can only happen with effective marketing and outreach.

We did not explore this element of deploying apps in GLAMS systematically, but we nonetheless encountered and studied the problem and can make a few general recommendations.

First, not all Americans have smartphones, sufficient data plans to download digital content, download apps, or know how to fully use their phones. To alleviate these issues, cultural institutions should invest in some older iPods or tablets. Lend them to users, for free, at the information desk. Alternately, help visitors download the apps, and then show them how to use it (as well as how to use their phones.) Many consumers, for example, don't understand QR codes, their phone notification settings (for beacons), or other features of their phone. In this context, engaging visitors about their phones is a critical part of app deployment in a cultural space. In institutions without formal information desks, such materials can be distributed to users at the front door.

Secondly, even a modest expenditure for developing a web app, and for developing its content, will require a small organization to make a significant sacrifice of precious staff resources and capital. Cultural organizations should insist on getting full functionality, including a package of data analytics (choosing freely available services, such as Google Analytics) to track visitors use of their mobile project. This can reveal patterns of use (or non-use) and push the institution to think critically about the role of the mobile project within its larger interpretive strategy. Likewise, an institution contemplating developing an app should consider the development process as a potential fund-raising or community endeavor, perhaps enlisting support through crowdfunding or through seeking help from a GiveCamp, in which programmers donate technical expertise to charity projects. Not only do such efforts raise funds or expertise, they help make a cultural institution's community aware of its planning and interpretive strategies, promoting buy-in as well as building audience engagement.

Finally, social media strategies often emphasize pushing information out to consumers, rather than inviting them into the organization. As GLAMs develop apps, they should view their deployment as adopting interpretive strategies that are more collaborative and less didactic. How, for example, can your app build games, citizen science approaches to interpretation, or social sharing into the visitor experience? Can you app be used beyond the doors of the museum—as a resource for a local school or community? By thinking holistically about mobile projects as building and engage audiences beyond the walls of the museum—not just inside those walls— such mobile engagement can move beyond being merely value added. The mobile project can help GLAMs to rethink their engagement strategies more broadly, recognizing how transmedia interpretation strategies are altering cultural organizations relations to their publics.

Conclusions
The goal of the project that led to this white paper was to explore how Curatescape could be reconceived and distributed for small to medium-sized museums. Our team and collaborators explored a multitude of approaches. We have concluded that the variety of spatial layouts for small museums creates special challenges, and we have developed a blueprint for implementing apps that could be generalizable across a wide range of small institutions. (And, we will seek additional resources to take us down this path.) Nonetheless, we believe that it is possible for small and mid-sized museums to implement low-cost custom solutions on their own. Toward that end, we have developed the following recommendations for cultural organizations with limited staff and/or financial and technical resources.

a) We recommend that such institutions not worry about native apps. Instead, they should seek to deploy web apps that use well-understood open-source software, such as WordPress.

b) Such solutions should be developed as part of a broader digital strategy, and be based in best practices in this area, including especially effective use of library metadata.

c) Mobile apps should make use of the possibilities of location awareness inherent in smart devices, including providing visitors with some ability to navigate a museum's spaces. This should include, at the least, a map of the physical layout of the museum or gallery, as well as metadata that connects in-app interpretive materials to the spaces of the museum.

d) More elaborate strategies would involve the use of QR codes, shortened URLs, or alpha-numeric data entry into the app. This allows for curators to call attention to moments of interpretation. Because work in this area is well understood, we recommend this strategy as a possibility.

e) Yet more elaborate beacon technologies can be used, although they are still a work in progress, at least relatively speaking and at this writing. Likewise, the use of GPS or Wi-Fi signals to triangulate location indoors is likely cost prohibitive.

f) No matter the technology, it also behooves institutions to create interpretive strategies that fully appreciate the possibilities of transmedia theory and practice. This will result in more sophisticated digital interpretation, which complements and extends physical exhibits.

g) Also, it is incumbent on curators to engage visitors through aggressive outreach and user education. This ensures that visitors are both aware of the technology and able to use it.

h) Organizations should support a BYOD (bring your own device) strategy. However, one could also argue for having a small fleet of inexpensive tablets or iPods available for visitors to use (in exchange for a driver's license.) Doing this alleviates interruptions (emails, texts, and other alerts) from a visitor's own smart device, and also has everything pre-loaded and ready to go.

Bibliography